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PERFORMANCE CONTINGENT REWARD SYSTEM: A FIELD STUDY OF EFFECTS ON WORKER PRODUCTIVITY

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An incentive program designed to improve individual productivity was developed and implemented in the data entry section of a data processing center at the Long Beach Naval Shipyard. The employees participating in the study were Navy civilian key entry operators. Production standards were developed based upon keying speed and the amount of time spent working. A Performance Contingent Reward System (PCRS) was designed in accordance with sound behavioral principles and federal guidelines such that a monetary bonus

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was awarded for high individual productivity. The amount of the reward was directly proportional to the amount of work exceeding a production standard.

Production for the 12-month trial period improved substantially, both in keying speed and in the time spent working. Excessive overtime and a heretofore perpetual backlog were virtually eliminated. The work force decreased in size but not in productivity as a few employees left the organization through natural attrition and were not replaced. A rigorous cost-effectiveness analysis showed that the set-up costs of the program were recovered in the first 3 months of operation.

The report describes work measurement and standards development; details of the PCRS, including performance-reward contingencies and the payment system; and suggestions for successful program implementation.

FOREWORD

This research and development was conducted in support of Exploratory Development Task Area ZF55.521.018 (Organizational Structure and Environment) under the sponsorship of the Chief of Naval Material (NAVMAT 08T). The incentive program developed in this project would probably be most appropriate in settings where work is amenable to measurement and where workers are generally free to set their own pace. The development which took place at the Long Beach Naval Shipyard (LBNS) has been implemented by that activity. A similar program has been implemented at the Mare Island Naval Shipyard, Vallejo, California, and plans have been made for implementing similar programs at the other Navy shipyards.

Appreciation is expressed to the management and employees of the Data Processing Office of the Long Beach Naval Shipyard (LBNS), Long Beach, California, for their participation and cooperation. Special thanks are in order for Robert Price, LBNS Incentive Awards Officer, for his sustained support and commitment to the project. Gratitude is also expressed to student research assistants T. Trent, K. Roger Williams, and Jacqueline Andersen.

J. J. CLARKIN
Commanding Officer

SUMMARY

Problem

Escalating manpower costs, coupled with tighter constraints on fiscal resources, necessitate the development and implementation of methods to increase the productivity of current and future work forces.

Objective

The purpose of this effort was to develop, implement, and evaluate a work motivation program designed to increase individual productivity among Navy civilian key entry operators in a manner that is perceived as positive by management and workers alike.

Approach

Low productivity may be attributed to a lack of ability, to poor motivation, or to both. The present approach was to simply accept ability differences as natural occurrences and to focus on changing the motivation to work. The method used was a wage incentive program wherein salary was guaranteed, but a bonus could be earned for above-standard performance. The amount of the bonus was directly proportional to the amount of work exceeding the production standard. A computer program was developed that essentially administered the entire work incentive program.

Findings

1. Productivity improved substantially, as indicated by (a) improved performance rates, (b) increased productive time, (c) reduced overtime, and (d) eliminated backlog.

2. Productivity improved during the first month and continued to improve throughout the 12-month trial period.

3. Management and nearly all the employees preferred to continue the program past the 12-month trial period.

4. Fewer individuals were needed to accomplish an equivalent amount of work.

5. Although there was no discernible change in the amount or pattern of absenteeism, the work center's overall productivity improved to the point that leave abuse no longer had an adverse effect on output.

Conclusion

An effective work incentive program can be established under current federal and Navy guidelines.

Recommendations

1. Performance contingent reward systems should be developed, implemented, and evaluated in other work centers where the work performed has characteristics similar to those described in this report.

2. Current federal and Navy incentive awards programs should be revised to provide greater emphasis and guidance for the development of programs specifically directed towards increasing individual productivity by rewarding superior work performance.

3. Types of rewards not currently available under federal regulations (e.g., time off) should be investigated.

4. Research and development should be directed toward (a) other monetary and nonmonetary rewards, (b) incentive systems for more complex jobs, (c) testing different performance-reward contingencies, and (d) determining more precisely the impact of incentives on performance.

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INTRODUCTION

Problem

Work incentive programs that reward individuals for high productivity are viewed with ambivalence by managers and behavioral scientists alike. The management and scientific literatures are replete with examples of incentive plans that were either great successes or miserable failures (Belcher, 1974). Although numerous reasons have been offered to account for the successes and the failures, the work incentive issue remains controversial and unresolved. Now, escalating manpower costs coupled with tighter constraints on fiscal resources necessitate the development and implementation of methods to increase the productivity of current and future work forces.

Objectives

The overall research objective of this project was to study the relationships between motivation and worker productivity. Specific research objectives included:

1. The validation and extension of a quantitative model of motivation designed to predict (a) level of job performance and (b) the impact of certain incentives and management practices on productivity.

2. The study of the effects of differential feedback on performance.

3. The study of the effects of a Performance Contingent Reward System (PCRS) on worker productivity.

The overall management objective of the study was to improve the efficiency of the work center. Specific management objectives included:

1. Improving productivity by increasing individual performance.

2. Reducing personnel administration problems by decreasing unplanned absenteeism, personnel turnover, and union complaints.

Research objectives 1 and 2 are treated more fully in Dockstader, Nebeker, and Shumate (1977) and in Nebeker, Dockstader, and Shumate (1978). This report focuses on research objective 3 and on the two management objectives; and describes and documents the development, implementation, and short-term results of a Performance Contingent Reward System.

Background

The research described in this report received its initial impetus when the Chief of Naval Material (CNM), during an annual program review of R&D in Navy laboratories, expressed concern about the productivity of Navy employees and expressed an interest in R&D in work motivation and productivity.

At that time, NAVPERSRANDCEN had recently completed a study of work motivation and productivity in the check-proofing department of a commercial bank (Nebeker & Moy, 1976). The purpose of that study was to further develop and refine an expectancy model of work motivation. The study proved quite successful in that the capability of the model to predict actual performance was better than that of similar research reported in the literature. Following this success, it was felt that the motivation model should be developed further by testing its applicability to other work settings and tasks. Because of CNM's interest in work motivation and productivity, a NAVPERSRANDCEN research team visited the Long Beach Naval Shipyard (LBNS), which, like other Navy shipyards, falls under the authority of CNM through the Naval Sea Systems Command (NAVSEA).

Three objectives were established for the initial site visits: First, it was necessary to obtain the support of the shipyard's Commanding Officer; the Head of the Industrial Relations Office; the Incentive Awards Coordinator; and the President, Local 2237, Graded Unit, American Federation of Government Employees (AFGE).

Second, the Commanding Officer's permission was required to conduct the study in the shipyard, and his approval was needed for the expenditure of shipyard funds in support of the research.

Third, it was necessary to determine which work center would be the most appropriate site for the study. Certain job characteristics were considered essential for testing the motivation model. Specifically, it would be preferable to study a production type job that (1) could be objectively measured, (2) was repetitive, (3) had or could have individual production records, and (4) was largely self-paced. The study also required a large enough pool of employees to allow for statistical analysis.

The LBNS's primary functions are the overhaul, repair (scheduled and emergency), maintenance, and conversion or modernization of Navy ships. The third largest of eight naval shipyards, it employs approximately 7,500 civilians. The CO, a Navy captain, had a supporting staff organized into offices (e.g., Management Information, Quality Assurance, Industrial Relations) generally headed by civilians, and departments (e.g., Planning, Production, Supply, Comptroller, Public Works) generally headed by Navy officers.

The search for an appropriate work center led to a talk with the Director of Management Information Systems, who indicated that his own Card Punch Section (CPS) might be a very good place to conduct the study because one of its problems was low productivity. Further examination showed that the CPS had a number of advantages:

1. The work involved a key entry task that was similar to the task in the earlier bank study (Nebeker & Moy, 1976). Such similarity provided an opportunity to test the capability of the motivation model to predict performance for a similar task in a different work environment. One important work environment change was moving from the private sector to the public sector.

2. The nature of the work met the established job characteristic requirements (i.e., it could be objectively measured, the task was repetitive, individual productivity data could readily be obtained, and the task was largely self-paced).

3. The aforementioned work characteristics also provided an opportunity to study the effects of feedback and goal-setting manipulations upon performance.

4. The relative ease of developing standards for the task, and the capability of tying performance to individual operators, would facilitate the development and implementation of a Performance Contingent Reward System based directly upon above-standard performance.

APPROACH

Hypothesis

Productivity in government work places can be substantially increased through a program of work incentives that are designed and administered in accordance with sound behavioral principles and that adhere to federal and Navy regulations.

Research Design

The research design resembled what Campbell and Stanley (1963) call "quasi-experimental." Specifically, it was a Time-Series Experiment, the essence of which is the "presence of a periodic measurement process on some group or individual and the introduction of an experimental change into this time series of measurement, the results of which are indicated by a discontinuity in the measurements recorded in the time series" (p. 37).

The LBNS study involved (1) taking periodic productivity measurements for several months before implementing the Performance Contingent Reward System (PCRS), (2) introducing the experimental treatment (the PCRS), and (3) taking subsequent periodic productivity measurements to look for a discontinuity (namely, improved productivity). In addition, a detailed cost/benefit analysis was to be conducted to assess the value of the PCRS in terms of the cost to develop, implement, and maintain the program versus savings to the government.

The establishment of an effective Performance Contingent Reward System of the kind described in the present report requires several important activities:

1. Defining the behavioral variables of interest.

2. Determining appropriate measures for the variables.

3. Collecting base line data on such variables over a period of time before the implementation of a PCRS for use in measuring improvement after the system has been installed.

4. Setting performance standards to assess individual performance and to determine rewards.

5. Designing a work flow system to ensure an equitable distribution of work.

6. Establishing performance-reward contingencies.

7. Designing a payment system.

Theoretical Considerations

Unlike experimental research designs, where conditions or treatments are predetermined, many decisions were made during the course of the study as new information was provided or discovered. Nevertheless, the work was theory-oriented from the outset: When situations arose that required changes, the

changes were evaluated in terms of relevant theories and hypotheses (see Appendix A for a brief summary of relevant theories; namely, expectancy theory, goal theory, and incentive theory). The following items are examples of important issues considered in the study that are currently receiving attention in contemporary theories of motivation:

1. A behavioral approach--The study's overall theoretical framework emphasized the necessity of establishing well-defined (observable, quantitative) work measures and objective performance criteria.

2. Goal setting--Implicit performance goals may have been established through the introduction of work performance standards.

3. Feedback--Individual performance feedback was provided each week in terms of both rate and volume.

4. Performance-reward contingency--Rewards were earned in direct proportion to above-standard performance.

5. Temporal considerations--Rewards were awarded as soon as administratively practical.

6. Reward magnitude--Efforts were made to increase the size of the reward to make it an effective incentive.

The Work Center

Staffing and Organization

The Card Punch Section (CPS) was under the supervision of the Automatic Data Processing Branch Head (GS-11) in the Operations Division of the Management Information Systems Office. The CPS was divided into day, swing, and graveyard shifts. Each shift had a GS-5 supervisor, who reported to the ADP Branch Head; and a GS-4 lead data transcriber, who acted as a part-time supervisor. CPS production personnel were GS-3 data transcribers (formerly called card punch operators). The number of transcribers varied during the course of the study but usually ranged from six to eight per shift (excluding the supervisor and the lead data transcriber).

Data Transcriber Tasks

The duties of a transcriber were to operate CMC 7 and IBM 029 data transcribing equipment to record data from a variety of sources. The two machines were quite similar, but the CMC operated more like a remote computer terminal in that it transcribed data directly on a disk and had separate, internally stored key-accessed programs for processing different source documents. Although some card-punch work was still being done on the IBM 029, nearly all work was to be transferred to the CMC.

Work Flow

Work input for the CPS took the form of handwritten documents to be transcribed into machine-readable form. Most of the source documents came in

batches from work sites throughout the shipyard and were routed through the Control Section, where various accounting-type functions were performed. Some work bypassed the Control Section and went directly to the CPS.

Before the study, CPS shift supervisors distributed assignments at the start of each shift by placing batched source documents on a table at the front of the room. Transcribers picked up batches and logged out their assignments. Finished work was logged back in and placed in a completed-work basket, and the cycle began anew. Supervisors sometimes delivered priority jobs but, in most cases, the work flow was self-paced, with transcribers picking up and delivering their own work.

Documents

The more than 300 source documents that comprised CPS input varied along several dimensions, including size; color; paper type; length and number of records per document; ratio of alpha to numeric characters; deviations from a top-down, left-to-right format; ratio of preprinted to handwritten entries; and whether individual characters were boxed or were just fields. Other variables included the number of documents or records per batch, the total volume or frequency for processing a particular document over some fixed period, and the legibility of handwritten entries.

PRE-INCENTIVE PROGRAM ACTIVITIES

Several important activities were necessary to prepare for the implementation of a Performance Contingent Reward System (PCRS), including (1) identification of productivity-related problems, (2) definition and measurement of variables, (3) collection of base line data, (4) coordination with unions, (5) administration of a questionnaire to data transcribers, (6) execution of a feedback study, (7) implementation of an interim incentive program (due to delays in the start of the PCRS), (8) implementation of certain improvements in work procedures, and (9) appointment of an Incentive Management Coordinator.

Problem Identification

Personnel Problems

At the study's outset, discussions with key personnel identified several problems associated with Card Punch Section (CPS) productivity or with the CPS itself.

First, the Director, Management Information Systems (Director) expressed concern about performance rates, leave abuse, and morale. He said that performance rates, expressed in keystrokes per hour (KS/HR), were lower than those of industry and that he would like to see transcribers perform at an average rate of 9,000 KS/HR in the "write" mode and 10,000 KS/HR in the "verify" mode. (The write mode refers to initial data entry; the verify mode, to rewriting the same input to check for errors. Virtually all of the work was verified.) Low productivity per se was not cited as a major problem, probably because clear and objective measures of productivity had not been determined. Productivity was, for the most part, a function of individual habit and environmental expediency. The controlling maxim was "get the work out." Leave abuses included unscheduled leave and leave without pay. Excessive absenteeism causes fewer people to do more of the work, resulting in (1) costly overtime, (2) increased workload on those present, and (3) lowered morale among those required to work overtime against their wishes. The Director's concern about morale probably was due, in part, to an excessive number of grievances filed by transcribers with the union representative.

Second, the Head of the Industrial Relations Office was pleased that the CPS had been chosen for the study, partly because so many labor relations complaints had been received from within the Management Information Systems Office. His assessment of the situation, especially in the CPS, was corroborated by the President of Local 2237 (AFGE), who described the transcribers' working conditions as very poor. However, she said that the workers' complaints were primarily interpersonal in nature, and none applied directly to worker productivity.

Organizational Problems

Most of the problems identified in the early stages of the study (e.g., low productivity, absenteeism) could be attributed to employee behavior. Subsequent interviews with data transcribers identified another set of problems that could more appropriately be attributed to management, or organizational behavior.

Scientists who study human behavior in organizations to to identify specific characteristics of an organization that may be related to productivity and job satisfaction. One such characteristic, organizational climate, is defined by Campbell, Dunnette, Lawler, and Weich (1970) as "a set of attributes specific to a particular organization that may be induced from the way the organization deals with its members" (p. 390). Campbell et al. identified various dimensions of organizational climate; those that appear relevant to the present effort were (1) consideration, warmth, and support, and (2) reward orientation. Other relevant organizational characteristics are reflected in the policies and procedures established to govern administrative functions.

Status. The level of consideration, warmth, and support given to the CPS might best be conveyed by a description of its status within the organization. The Director described the CPS as being on the "bottom of the pile" with respect to the job's importance to data processing's overall mission. Such a negative view of the keypunch function is not universal. For example, management in another Navy shipyard involved in a concurrent study of the same job held the view that, while the grade level was low, the job itself was extremely important to the department's overall effectiveness.

LBNS transcribers' perceptions of the low status of their job could have been reinforced by a number of conditions; for example, comparative levels of pay. One operator remarked that the section janitor probably earned more than she did even though her job required a skill, was more demanding, and included a fair amount of responsibility. In fact, not only did the janitor make more money than a transcriber, but he earned exactly the same pay as a shift supervisor.

Obviously, some group in any organization has to occupy the lowest pay grade. If relative pay grade were the only indicator of the low status ascribed to transcribers, then perhaps the low grade level would not have caused as much concern among the transcribers as it did. However, at least two other conditions within the organization magnified the situation for a number of operators, some of whom subsequently left the organization.

First, many of the transcribers knew about other government organizations where data transcribers were GS-4s. The Long Beach operators knew that they weren't the only GS-3 transcribers, but the more serious aspect of this situation was that the transcribers saw no effort by management to get their position up-graded.

Second, the relationships between the operators (including supervisors) and management were poor, sometimes quite adverse. There was also a fair amount of friction among transcribers on a given shift, and between supervisors and transcribers. These negative environmental factors contributed significantly to the transcribers' perceptions of low job status, and resulted in frequent complaints to the union representative.

Reward Orientation. The second dimension of organizational climate identified by Campbell et al. (1970) is the degree to which the organization fosters a reward-oriented work environment. The reward orientation may take

the form of a formal reward policy that includes promotions, bonuses, or letters of commendation. Alternatively, it may be quite informal, including rewards in the form of pats on the back, "well dones," or special privileges. A scale could be designed to describe the reward orientation of an organization: Placement towards one end of the scale would indicate that an organization has very little regard for reward systems, while placement towards the other end would indicate that reward is viewed as a valuable, operative force in day-to-day activities.

Based on a comparison of the number of Special Achievement Awards given to CPS personnel over a given period with those given throughout the shipyard, it would seem that the organization of which the CPS was a part had little regard for the value of reward in day-to-day activities. Indeed, CPS employees indicated that no one had received any kind of official recognition for at least the past 5 years. While it may be true that no transcribers deserved such an award, the great amount of variance in performance across the transcribers suggests otherwise. Clearly, some operators were contributing far more to the organization than were others, even though they received no official recognition.

First-line Supervision. In most organizations the most common complaints from managers and workers alike center on the perceived inadequacy of the first-line supervisor. The supervisor's role of transforming management requirements into worker output makes him especially vulnerable to criticism. In addition, most first-line supervisors come from the ranks of workers and are not always selected on the basis of their possession of the skills that are characteristic of good supervisors. Usually, managers are trained to be managers and workers are trained to be workers. Supervisors, on the other hand, usually are trained to be workers and are required by their jobs to be managers.

The CPS's supervision problem had two major components: First, while the supervisors displayed certain positive characteristics, other supervision-related problems were manifested in such areas as job competency, interpersonal skills, and work distribution. For example, one assistant supervisor said that she would be much happier as a transcriber, but making the change would result in lower pay and retirement benefits. The second component involved shift supervisors' lack of authority. They could neither hire, fire, nor formally reward good performance. Their primary task was to get the work out, but they were not given the freedom (in terms of authority) required to do so most effectively.

Theory and empirical evidence indicate that the supervisor is a key figure in an effective incentive program. Unfortunately, however, it is not uncommon for the first-line supervisor to lack the authority to make such a program work. Managers who lack confidence in the supervisors below them tend to limit the delegation of authority, which weakens the supervisors in the eyes of the workers. The workers, in turn, work below capacity, thus confirming the manager's initial perceptions of the supervisors.

Variable Definition and Measurement

Motivational problems in a work setting produce some fairly typical symptoms; namely, low performance and job satisfaction, high absenteeism and job turnover, and excessive complaints to union representatives. Such classic symptoms provide places (or work behaviors) to begin the search for problem areas.

Performance

Performance vs. Productivity. A performance rate standard may not accurately reflect a productivity or volume standard. Actually, armed with rate data alone, it would be inappropriate to identify productivity as a problem at all. A productivity standard is generally defined as rate multiplied by hours worked at that rate. In the early stages of the study, it was assumed that hours worked on the machines would be fairly well controlled; the need to distinguish between a rate standard and a productivity standard did not become apparent until later.

The difficulty of identifying productivity as a problem lies in the notion that productivity refers to the amount produced. The explicit definition of productivity as a problem in this study required knowledge of the number of hours worked at a given rate as well as knowledge of the rate of work. For example, assume that 15,000 KS/HR is excellent performance for a key entry task while 8,000 KS/HR is average or slightly below. If one transcriber works at 15,000 KS/HR but operates the machine for only 1 of 2 assigned hours, while another works at a rate of 8,000 KS/HR for the full 2 hours, then the second worker is, in terms of the amount produced, the better worker. If the two operators were judged in terms of rate alone, then the first operator would be considered the better worker regardless of actual production.

In many work settings, rate controls most of the production variability because the number of hours worked is typically controlled by a supervisor or by some other formal mechanism (e.g., time clocks). However, hours worked may also need to be measured if an individual can control his own production time during the time available. Any attempt to increase productivity by setting a higher rate requirement may not improve productivity at all without a corresponding requirement and opportunity to maintain or increase the time spent performing the task.

The Shift Activity Report. Although rate and machine time statistics were readily available in the CMC-produced Shift Activity Report (SAR) (Appendix B), no productivity records (either in terms of rate or machine time) were being monitored systematically at the study's outset. The SAR had been used periodically by management to obtain performance data for various purposes but was not being used to monitor performance for any kind of production management system.

The SAR is an integral part of the CMC system and is produced on demand at the control console. It contains various performance statistics

for each operator, including machine use (in minutes), the total number of keystrokes and records produced in a specified interval, and average keystrokes per hour. All four statistics are reported for both the write and verify modes. Also recorded is the number of errors detected during verification.

Performance Rate. Performance rate, although inadequate as the sole measure of overall productivity, is nonetheless probably the most important component of overall productivity in most work settings. Performance rate for a key entry task may be expressed in a number of different ways, depending upon what is counted (e.g., keystrokes, records) and upon the interval of the count (e.g., minute, hour). Keystrokes per hour (KS/HR) was selected as the rate measure for the study because it was familiar to most key entry operators, because it was less variable than measures such as records per hour, and because it was the measure used by the Director to describe productivity.

Machine Time Use

Although machine time use was mentioned earlier, it was not originally identified as a variable of interest. However, its importance to overall productivity was discovered in the process of recording weekly performance rates from the SAR. In many instances, the actual time spent working at the machine by a given operator was less than expected relative to the time available. The total time available to work at the machines, excluding breaks, was 7 hours and 40 minutes for the day shift, and 7 hours and 25 minutes for the swing and graveyard shifts. However, early reports showed a total usage of only 8 hours per machine for all three shifts combined. Although other time allowances (e.g., personal time, setup time, administrative time) must be considered in determining a reasonable number of hours that should be worked, machine time use was clearly too low.

Backlog and Overtime

It was discovered during the study that management was using two additional variables to measure productivity: Average daily backlog and overtime hours. A backlog count was taken daily at the end of the swing shift. The unit of the count, a "batch," was comprised of any number of source documents at various levels of difficulty. The count provided management with a crude daily estimate of incomplete work. It was considered very unlikely that adding any degree of precision to the measure would make an important difference in terms of the value of the measure to the organization or to the project, so the batch was retained as the unit of measurement for backlog.

The relationship between average daily backlog and overtime hours would be expected to be quite high: If there is no backlog, then there should be no need for overtime work.

Morale

The first formal contact between data transcribers and the research team occurred during interviews that were designed to gather information for

use in the construction of a transcriber questionnaire. Specifically, the interviews were intended (1) to identify problem areas, (2) to obtain job content information required to construct a questionnaire, and (3) to identify the kinds of rewards (both monetary and nonmonetary) that might have incentive properties for the transcribers. Although monetary rewards can be effective incentives, other work-related activities can also serve as motivators (e.g., temporary assignment to desirable work areas or duties).

A short list of questions (Appendix C) was designed to elicit the kinds of information required. Interviewing began with groups of four to six people. At the end of the first group interview, the transcribers were asked if they wanted to talk privately with the interviewers. So many responded that the team switched to individual interviews, which lasted from half an hour to an hour.

Most of the problems described by the transcribers during the interviews were primarily interpersonal in nature, involving relationships (1) between the CPS and the rest of the data processing shop, (2) between management and first-line shift supervisors, (3) between shift supervisors and transcribers, and (4) among the transcribers themselves.

Although several transcribers identified "pressure on the job" as a problem, the pressure was not due to job performance requirements but, again, to interpersonal relationships. A salient example was the "wall" problem: In an open bay, the CPS was sectioned off by standard 6-foot office dividers. The dividers were arranged to create three accesses to the section, but the Division Manager had blocked the access nearest his office with a 5-foot bookcase to reduce distracting machine noise. Unfortunately, that particular access had provided the most direct route to the coffee area for the transcribers seated nearest the rear of the section. The Division Manager's action was perceived by some transcribers as a form of snub or punishment, and day-shift workers complained that he sometimes looked over the bookcase to check up on them. To the transcribers, the Division Manager's checking up on them constituted a form of pressure.

The interviews also elicited some fairly common charges of supervisory favoritism, inequitable work assignments, limited opportunity for career progression, and low pay. Other complaints, which were more directly related to productivity, concerned illegible source documents, outdated procedures, insufficient training, poor supervision in terms of job knowledge and assistance in day-to-day problems, and overwork.

Absenteeism. Absenteeism is simply the habitual failure to be at work. The Director called the CPS absentee problem leave abuse, or excessive unscheduled leave. Unscheduled leave refers to leave that (1) has not been forecast, (2) is taken without appropriate advance notice, or (3) is not authorized. It causes a particularly difficult work management problem in that it disrupts work planning, scheduling, and distribution. However, leave abuse is difficult to control, and it is probably best to let the first- or second-line supervisor determine whether absenteeism is causing work management problems. In this study, such a determination was made on the basis of an oral report by the ADP Branch Head, the second-line supervisor.

Base Line Data Collection

Base line data provide benchmarks with which to measure change. The major problem is selecting base line measures that provide both (1) an accurate and adequate representation of the phenomenon of interest (e.g., performance) and (2) the best estimate of change. An example of a violation of condition (1) would be the use of KS/HR as a measure of productivity without considering machine time use. An example of a violation of condition (2) would be the use of machine time use rates alone to indicate success or failure in keeping transcribers working at their machines. Decreasing machine time use rates over time could easily be interpreted as showing a lack of motivation to work at the machines, when they may actually reflect a lack of work in the CPS.

A performance base line was determined from data in the SAR that were collected daily and forwarded to NAVPERSRANDCEN each week. Initial monitoring verified that the performance rates (8,100 KS/HR in the write mode; 9,600 in the verify mode) were lower than desired by the Director (9,000 write; 10,000 verify).

When it became apparent that machine time use was an important production variable, it was also recorded from the SAR. The number of overtime hours worked and the size of the average daily backlog were obtained from records maintained by the Branch Head.

Absenteeism initially was monitored using each employee's Service Card, which gives a daily accounting of attendance, hours worked, annual and sick leave, leave without pay, overtime, etc.

Union Coordination

Approximately 35 percent of the transcribers belonged to the American Federation of Government Employees (AFGE). The AFGE had no bargaining rights in such areas as pay and compensation, leave policy, and retirement benefits, but incentive program activities that affected working conditions fell under union purview and had to be coordinated with the local representative. For example, a union member might claim that work standards set for the incentive program were too high and favored those transcribers with high ability, leaving out those who worked hard but did not have the ability to earn incentive money.

Upon the recommendation of the Director the AFGE representative was briefed about the study before employees were contacted. On another occasion, the local representative asked that a higher union official be briefed. The program fared very well under union scrutiny and the consensus was that it satisfied typical union concerns; that is; it posed no threat to job security, the employees participated in its development, the standards appeared to be reasonable, and participation was voluntary. Work was coordinated with the union representative throughout the course of the study.

The Questionnaire: A Structured Interview

The primary function of the questionnaire was to obtain information about the transcribers and their job in a form that was compatible with the work motivation model described in Nebeker, Dockstader, and Shumate (1978).

The questionnaire (see Nebeker, Dockstader, & Shumate, 1978) was designed to obtain quantitative estimates of the model's components. For example, transcribers estimated their ability to perform at a given level (e.g., 8,000 KS/HR) by indicating on a 100-point scale the likelihood that they could perform consistently at that level. Seven levels of performance were established, ranging from considerably below average to considerably above average. Verbal anchors or labels were used to help the transcribers to understand the questions. For example, the anchors for estimating ability to perform at a given level of performance ranged from "I can't do it" (0 on the scale) to "I can do it every time" (100 on the scale). The anchors for estimating the probability of obtaining an appropriate reward for performing at a given level ranged from "never happen" (0) to "absolutely certain" (100).

Importance scores for different possible outcomes (e.g., rewards, fatigue) were determined by using a 21-point scale ranging from -10 ("I would do anything just to avoid it") to +10 ("I would do anything just to get it").

The questionnaire was designed to be self-administered with a minimum of direction, but many of the transcribers could not answer some of the questions without help. The transcribers also varied greatly in the time required to complete the questionnaire, ranging from half an hour (as originally intended) to an hour and a half. For these reasons, it became necessary to lead many of the transcribers through the items individually or in small groups. In this sense, the questionnaire was much like a structured interview.

The Feedback Study

Early in the study, before any incentive manipulations, a feedback study was conducted to test a postulate of goal theory (Appendix A) that states that an individual will set a goal spontaneously if he receives feedback relating his own performance to a standard (Locke, 1968; Locke, Cartledge, & Kneer, 1970). The underlying assumption is that, although no explicit performance goal is established by an organization, an individual's knowledge of his own performance relative to the group standard stimulates implicit goal setting and results in increased performance.

The feedback study involved a comparison of two groups. After base line performance data (KS/HR) had been collected for 3 months, data transcribers were informed of their own performance rates each week. The information was given directly to them in sealed envelopes. Individuals in one group were told only of their own performance rates, while those in the other group were given their own performance rates plus the average performance rate for the entire section.

During the base line period when there was no systematic feedback, performance for the two groups was essentially equal (Figure 1). With the introduction of the treatment manipulation--in this case, individual feedback only (IFO) versus feedback plus standard (FPS)--a significant divergence occurred during the first month and the difference continued through the following 2 months.

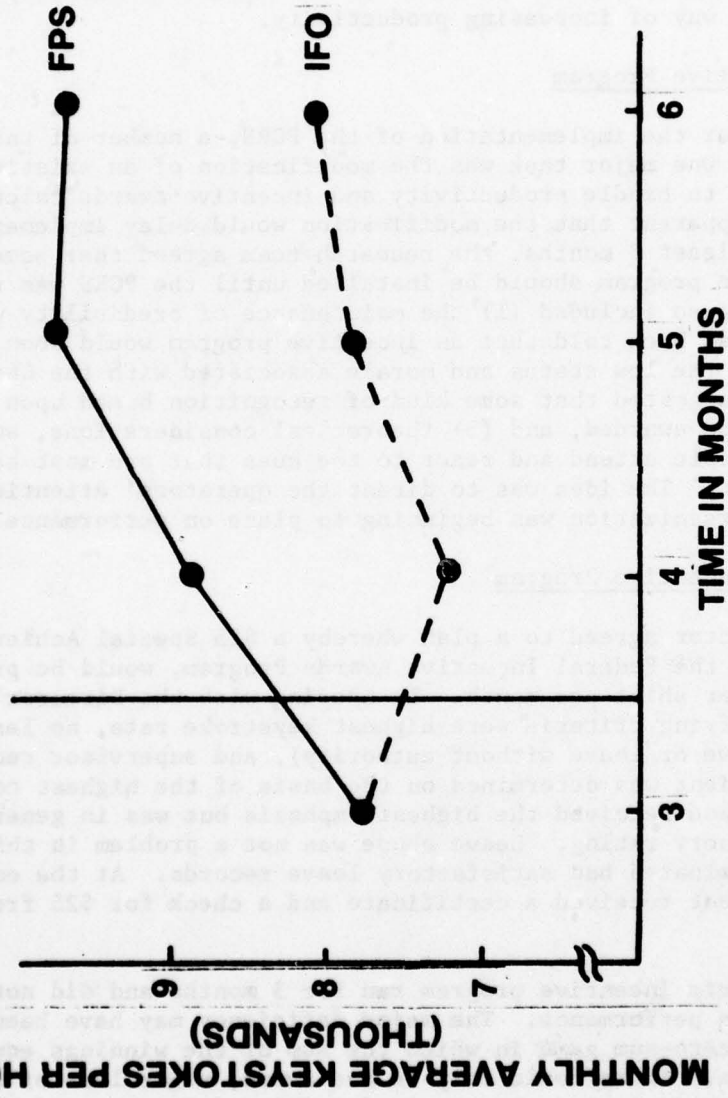

Figure 1. Average monthly performance rates (KS/HR) as a function of Feedback Plus Standard (FPS) and Individual Feedback Only (IFO).

There are several important questions regarding interpretation of the apparent increase in performance in the FPS condition. Given only the information provided here, the difference between the two groups might easily be attributed to goal clarity or more meaningful feedback for the FPS group. (For a complete description and discussion of the study see Dockstader, Nebeker, & Shumate, 1977.) However, the study does provide evidence regarding the motivational properties of performance feedback, particularly when accompanied by group performance information. The practical implications for a manager or supervisor should be obvious: Relative feedback may provide a very inexpensive way of increasing productivity.

An Interim Incentive Program

To prepare for the implementation of the PCRS, a number of tasks faced LBNS personnel. One major task was the modification of an existing computer program designed to handle productivity and incentive awards calculations. When it became apparent that the modification would delay implementation of the PCRS for at least 3 months, the research team agreed that some sort of interim incentive program should be installed until the PCRS was ready. Reasons for doing so included (1) the maintenance of credibility with the operators, who had been told that an incentive program would soon be established, (2) the low status and morale associated with the Card Punch Section, which suggested that some kind of recognition based upon high performance should be awarded, and (3) theoretical considerations, such as the fact that people attend and react to the cues that are most salient in their environment. The idea was to direct the operators' attention to the importance the organization was beginning to place on performance.

A Zero-sum Incentive Program

The Director agreed to a plan whereby a $25 Special Achievement Award, provided through the Federal Incentive Awards Program, would be presented to one individual per shift per month. In keeping with the Director's stated goals, the qualifying criteria were highest keystroke rate, no leave abuse (unscheduled leave or leave without authority), and supervisor recommendation. The reward recipient was determined on the basis of the highest composite score. Performance received the highest emphasis but was in general agreement with the supervisory rating. Leave abuse was not a problem in this case because those nominated had satisfactory leave records. At the end of the month the recipient received a certificate and a check for $25 from the Branch Supervisor.

The interim incentive program ran for 3 months and did not appear to have an impact on performance. The major deficiency may have been that it operated like a zero-sum game in which the sum of the winnings equals the sum of the losses. There could only be one award, regardless of effort; if an individual came in second, he received nothing. To compound the problem, the award usually went to the same people. While a zero-sum program may be appropriate in some areas where the stakes are high and the individuals involved have high opinions of their abilities, it did not appear to be a good program for the CPS.

Local Publicity

To maintain a focus on productivity and to raise the morale of data transcribers, an article about the interim program was published in the shipyard newspaper. The article, titled "Hard Work Pays Off," was published along with a photograph of the award recipients, the Head of the Operations Division, and the Director.

Work Procedures Improvement

In September 1976, the incentive system was ready for implementation. The research team briefed the Director and his staff on the program's procedures and mechanics, and suggested some work improvement procedures:

1. Shift supervisors should not operate the machines. They should spend their time doing supervisorial tasks such as preparing work, distributing work, operating the CMC console, training, updating procedures, and answering questions.

2. Data transcribers should not pick up and return their work. Work should be assigned, delivered, and picked up by the supervisor, allowing transcribers to remain at their stations and thereby reducing nonproductive time.

3. Individual copies of all current procedures should be placed at each station for ready reference. This change was also aimed at increasing productive time by keeping transcribers at their stations.

The data transcribers were also briefed about the program and were given a handout explaining how incentive money could be earned. Special emphasis was given to increasing time worked at the machine as well as increasing performance rate (KS/HR).

The program was very well received by management and the transcribers. A PCRS implementation date of 1 October 1976 had been suggested, but the Director decided to wait until 3 January 1977 to give the work improvement procedures time to take effect.

The Incentive Management Coordinator

Because so much time was consumed by administrative and conceptual problems associated with the project, the research team proposed to the Director that a member of the Management Information Systems staff be appointed to conduct liaison between the shipyard and NAVPERSRANDCEN. Selection criteria included (1) having the trust of management, data transcribers, and the research team, (2) having the job knowledge required to maintain credibility with transcribers, and (3) favoring the incentive plan and being able to understand and apply the principles underlying the PCRS.

A list of coordination responsibilities (Appendix D) was developed that (1) could be adequately handled by someone without an R&D background, and (2) would help ensure the program's success. The Director agreed with the concept and an Incentive Management Coordinator was selected and trained. The value of having an Incentive Management Coordinator cannot be precisely determined from this project because circumstances required her time elsewhere. However, experience and the nature of the changes inherent in the PCRS indicate the need for such a coordinator.

A PERFORMANCE CONTINGENT REWARD SYSTEM

Overview

A Performance Contingent Reward System (PCRS) is one in which reward is dependent upon some specific work-related behavior (e.g., performance, cooperation, attendance). The overriding concern in the development of a reward or incentive system is to correlate reward with behavior to the greatest extent possible. In this regard it is critical (1) to define the desired behavior clearly and specifically, and (2) to tie the reward directly to such behavior. In doing so, it is important to recognize that there are both qualitative and quantitative dimensions of any behavior-reward association.

Qualitative dimensions identify and specify different types of behaviors. For example, if an incentive program is designed specifically to improve work output, then a subsequent reward should not be withheld if an individual attains the work output goal but also spends an excessive (defined by the organization) amount of time in the coffee lounge. The behaviors "work output" and "amount of time in the coffee lounge" are qualitatively different. It follows, of course, that if the behavior of interest is a combination of the two, then the behaviors should be so defined and the incentive system so tailored. Rewards, like behaviors, also differ qualitatively. For example, a monetary reward is different from an opportunity for cross-training or for time off the job. The latter two outcomes could, of course, be translated into monetary terms, and all three incentives may be equal in cost to the organization but not in incentive value to the individual.

Whereas qualitative dimensions concern types of behavior or reward, quantitative dimensions concern the amount of a specific behavior or reward. In developing a PCRS, an acceptable or standard level of performance must be established. Similarly, an optimal amount of reward, given some specified amount of the desired behavior, must also be determined. Quantitative issues include such questions as how much of a given behavior is required to qualify an individual for a reward, how large the reward should be, and what the relationship should be between the amount of behavior and the reward.

The PCRS installed at the Long Beach Naval Shipyard (LBNS) was basically a wage incentive program designed to increase productivity directly and job satisfaction indirectly. The goals were to be accomplished through a monetary incentive system provided by the Federal Incentive Awards Program to reward employees who perform at production levels above a standard. In the present study, data transcribers were rewarded in direct proportion to the amount of work exceeding the standard.

Under the wage incentive program established at LBNS (see Fein, 1971 for a description of various kinds of wage/incentive programs), the employees continued to receive their regular wages and benefits. In keeping with the maxim "incentive pay for incentive work" (Patten, 1974), the PCRS directly affected only those who chose to work above the standard productivity rate.

One advantage of such a program is that neither the individual nor the organization can lose. If an employee elects not to work at a productivity rate above standard, then he loses nothing as long as performance meets minimum requirements. However, in the LBNS Card Punch Section (CPS), no minimal performance level had ever been determined and, as far as the research team could determine, no data transcriber had ever been fired solely on the basis of low productivity. The PCRS was designed to benefit the organization as well as its employees in that the size of the reward was based on savings to the organization. The primary reward vehicle for implementing the monetary incentive program was the Special Achievement Award described in the Federal Personnel Manual, Chapter 451, Subchapter 3 (1976). The amount of the reward was determined by a scale derived for instances where "tangible benefits," in terms of government dollars saved, could be documented. Tangible benefits were realized through production that exceeded what the organization had established as a normal day's work.

The actual size of the reward was 11 percent of the amount saved through high individual performance. One way to view the concept of savings is to think of the money saved by an organization when one individual does his own work plus some fraction of the work of another hypothetical employee. If an individual is performing at 150 percent of standard, then he is essentially doing his own work plus half of the work of another. If two people consistently perform at 150 percent of standard, then they collectively save the organization the costs of one billet. Thus, the savings to the organization are considerably more than those resulting from increased productivity alone; they also include the eliminated costs of recruiting, selecting, training, and providing personnel administration for fewer people.

Standards Development

The earlier discussion of the quantitative dimensions of performance stated that a PCRS requires a clearly specified and acceptable (to the organization and its employees) performance standard, defined as a performance level that represents a fair day's work. However, developing fair standards is often difficult, particularly as jobs become more complex. Jobs differ in many ways, and it is probably due to such differences that work in standards development has generated so many different methods (e.g., Method-Time-Measurement, work sampling) and continues to receive a great deal of attention from industrial engineers.

If all employees in a particular production work center perform the same task, then a standard can be established based on the number of units produced. However, if tasks vary in difficulty and some take more time to complete than others, then an absolute measure of units produced may be inappropriate. Such is the case with data transcription, where source documents vary along several dimensions that can affect performance. In a PCRS of the present kind, it is imperative that work assignments be distributed so that workloads (particularly work availability) are approximately the same, thereby allowing each individual an equal opportunity to achieve a desired production rate based upon personal ability and motivation.

The goal for setting work standards was to place all of the source documents into as few categories of difficulty as possible. (Note that each source document had one or more sets of data entry instructions, called procedures, associated with it. Standards were actually determined for the procedures, not for the source documents.) Three methods were used to determine standards. First, a staff member surveyed the transcribers and had them assign procedures to categories on the basis of speed of transcription. The operators came up with different numbers of categories, making it extremely difficult to arrive at a satisfactory solution.

Next, a sorting technique was tried whereby certain data transcribers, selected on the basis of job experience and exposure to the greatest number of documents, were asked individually to sort the procedures into five categories based on their estimates of the speed with which the procedures could normally be keyed. The categories ranged from slow (3,000 KS/HR or less) to fast (over 12,000 KS/HR). Unfortunately, the interrater reliability (agreement among transcribers) was so low using this method that it, too, was abandoned.

The method that finally proved satisfactory was based upon the group's average performance rate for each procedure. The method is not very sophisticated but, as Grillo and Berg (1959) pointed out, the degree of accuracy when using a group average to set performance standards depends upon the reliability of the records used. Key entry work produces a highly reliable record. One problem of using this method at LBNS was that not all transcribers worked on the same procedures. Computing group means with partial group data may decrease the accuracy of the mean and, in this situation, produce an inaccurate standard. Therefore, missing data were supplied through the application of a general linear mathematical model (Ward & Jennings, 1973) that considers performance relationships for the transcribers on common procedures. The final outcome was a performance rate for each procedure, based upon the Ward-Jennings estimated average rate for all of the operators on every type of job.

The standards used in the present PCRS application took the form of performance categories that were determined by (1) ordering the procedures in terms of performance rates (speed) and (2) looking for naturally occurring rate clusters. The resulting five rate categories are presented in Table 1.

Since there was general agreement that performance rates were low in the CPS, each procedure average was rounded upward to the nearest multiple of 500 and placed in one of the five categories. Rounding raised the values of the derived standards approximately 5 to 10 percent above the calculated standards based upon averages estimated from historical records.

Table 1

Performance Rate Categories
(In Average KS/HR)

	Procedure	
Category	Write	Verify
1	4,000	6,000
2	5,500	7,000
3	7,500	9,000
4	10,500	12,500
5	12,500	15,000

Equitable Work Distribution

Because of the importance of equitable work distribution for the success of a PCRS, the system implemented at LBNS ensured that being assigned slow (difficult) work would not affect an operator's chance to earn an incentive bonus. This was done by adjusting the individual's actual rate for a given procedure using the standard rate assigned to that procedure. For example, if an individual was assigned difficult material, then the time spent working on it was weighted higher (given more credit) than an equal amount of time spent on easier procedures. Such a system solves the fair work distribution problem and allows the transcribers to concentrate on their work without having to worry about getting "stuck with the bad stuff" and thus missing a chance to earn a bonus.

Computer Administered Incentive

One very positive feature of the Long Beach PCRS was its degree of automation. All calculations and all but one simple data input were performed by computer. Before the study began, the CMC System was producing just the Shift Activity Report (SAR) (Appendix B). The research team asked that the Operator Analysis Reporting System (OARS), which was available as a CMC software package, be set up to monitor performance in the CPS.

The OARS was designed to monitor individual transcriber performance. It identified each transcriber by an assigned number and provided such information as the transcriber's shift, the procedures performed (identified by an account code and format number), performance rates (KS/HR) on each procedure, and the time taken to complete each procedure. In short, it provided a fairly comprehensive accounting of the work performed by each transcriber.

Under the direction of the research team, the OARS was modified (OARS II) to accommodate the PCRS (see Appendix E for a sample OARS II report). OARS II played a major role in the program's administration by collecting and storing

relevant productivity data, determining production efficiency, and calculating earned incentive bonuses based directly on individual work performance.

The OARS II program was run at the end of each week. Before each run, data indicating the amount of time each transcriber was assigned to the machine by the shift supervisor was entered into the system. Such assigned time data comprised the program's only manual entry.

One copy of the OARS II was mailed to NAVPERSRANDCEN each week to allow for program monitoring. The data transcribers were given that portion of the report containing information regarding their own productivity and the status of their incentive money accounts. They could see their incentive earnings for the past week and for the year to date.

An important feature of a computer-administered incentive system, particularly as it relates to a PCRS, is the highly specified nature of performance-reward relationships, both qualitatively and quantitatively. There was no ambiguity regarding what behaviors were of interest to the organization and the associated quantitative relationship between productivity and reward.

The Incentive Formula

OARS II used the following incentive calculation formula:

$$\text{Bonus} = \left(\begin{matrix}\text{Production}\\ \text{Efficiency}\end{matrix} - 1\right) \times \left(\begin{matrix}\text{Machine}\\ \text{Time}\end{matrix}\right) \times \left(\begin{matrix}\text{Recharge}\\ \text{Rate}\end{matrix}\right) \times \left(\begin{matrix}\text{Sharing}\\ \text{Rate}\end{matrix}\right)$$

Production Efficiency

Production efficiency is the product of two performance measures, percent efficiency and productive time. The first, labeled "% EFF" on the OARS II report, is a ratio of the actual performance rate (KS/HR) and the associated standard rate (STD/HR). If the actual rate was the same as the standard rate, then the individual worked at 100 percent of standard, or an expected rate of work. A percent efficiency greater than 100 (e.g., actual rate of 9,786, standard rate of 9,000) indicated performance above the standard (9,786/9,000 = 1.09 or 109% efficiency).

The second measure, productive time (labeled PRO TIM on OARS II), is a ratio of the time spent working at the machine and the time assigned to work at it. Because of authorized breaks, setup and cleanup times, and miscellaneous personal time, a full day's work on the machine was considered to be 75 percent of the time assigned. Thus, for an 8-hour day this would mean that 6 hours on the machine comprised a full day's work. In addition, any portion of the 8 hours could involve assignments other than key entry work such as administrative duties. OARS II identified such time as "OTH" (other time). OTH was also used to account for time when the section ran out of work.

For example, if a transcriber had been assigned to work 5 hours on the CMC (plus 3 hours on "OTH" and on the IBM) and the machine recorded 3.75 hours, then productive time would be 100 percent (3.75/5 x .75). If a transcriber's recorded time exceeded 75 percent of assigned time, then it was possible for productive time to exceed 100 percent. Most of the gain in

productive time resulted from decreased personal time. The limit on productive time was 125 percent, which would be approximately equal to working a full 8 hours after breaks.

If a transcriber had a percent efficiency score of 109 for the week and a productive time score of 115, then his total efficiency (production efficiency) would be 1.09 x 1.15 = 1.25, or 125 percent.

Machine Time

Machine time is simply the amount of time spent operating the CMC and IBM machines.

Recharge Rate

Recharge rate is the estimated hourly fee the organization charges to provide data entry services to a customer (i.e., another LBNS department). It includes the employee's salary plus acceleration costs (leave and fringe benefits) and some overhead costs. The figure is determined by local management; at the time of the study, LBNS's recharge rate for the CPS was $10.82.

Sharing Rate

Sharing rate represents the percentage of money saved that is to be returned to the employees for increasing productivity. The savings are based upon tangible benefits, which are defined as the difference between what a fair day's work would have cost versus what it actually cost due to above-standard productivity. Guidelines for determining both tangible and intangible benefits, plus suggested sharing rates, are provided in the Federal Personnel Manual, Chapter 451 (1976). For the present study, the sharing rate was set at 11 percent.

The following is an example of how the various factors would be used to calculate a bonus:

If the aforementioned hypothetical transcriber worked 5 full days at the 125 percent production efficiency rate derived above, then his bonus would be calculated as follows: (1.25 - 1) x (40) x ($10.82) x (.11) = $11.90.

The Payment System

The final step in the PCRS cycle is to deliver the reward. The method chosen for the present study, agreed to by the Management Information System Office, the Incentive Awards Officer, and the research team, was to allow bonus money to accrue until it reached $25. When it reached that amount, the transcriber had the option of withdrawing all or a portion (at least $25) of the bonus or letting it continue to accumulate. If she desired payment, then she informed her supervisor. A memo was then sent by the ADP Branch Head to the Incentive Awards Officer, who prepared the essential documentation (which involved making a few entries on a standard form). A copy of the form would go to the payroll office and, depending upon the submission date, the transcriber received a check from the Branch Head on the next payroll cycle, separate from the payroll check. At the request of

the Incentive Awards Officer, no individual was issued a bonus check more than once a month. The payment system was therefore very simple and involved very little time or effort.

RESULTS

The results reported here are short-term, covering the first 12 months after implementation of the Performance Contingent Reward System (PCRS) and pertain only to the effects of that program on the following six criterion variables: performance rate, productive time, production efficiency, overtime, average daily backlog, and absenteeism.[1]

Performance Rate

Performance rate, expressed in keystrokes per hour (KS/HR), is perhaps the most familiar criterion measure for a data entry task. It was also selected by the Director, Management Information Systems, as the best available indicator of productivity. Figure 2 shows the average monthly performance rates for 3 months before implementation of the PCRS and for 12 months afterward. The data represent the average rate for both the write and verify modes, weighted in proportion to the amount of time spent doing each. The data points in Figure 2 are based on the performance of 17 data transcribers who were on the job in October 1976 and were still present in December 1977 (14 of the original 17). The horizontal line in Figure 2 at the 9,500 KS/HR rate represents an average of the Director's goals of 9,000 and 10,000 KS/HR for write and verify, respectively. The vertical line in early January represents PCRS implementation.

It is clear from Figure 2 that performance improved immediately during the first month after implementation of the PCRS. Performance improvement between the months of December 1976 and January 1977 was statistically reliable ($t = 2.120$; $p < .05$). Improvement continued throughout the 12-month trial period appearing to level off during the last half of the year. The Director's goal was surpassed during the second month. An increase from approximately 8,700 KS/HR pre-PCRS to approximately 10,250 KS/HR 12 months post-PCRS represents an 18 percent improvement in performance rate.

Productive Time

Productive time, which is the ratio of the time spent working at a machine to the time assigned to do so, was not calculated before the Operator Analysis Reporting System (OARS) computer program was modified (OARS II) to accommodate the PCRS. Thus, there is no pre-PCRS measure for productive time against which to measure post-PCRS improvement. The closest thing to it was machine hours per day, which indicates average machine time use per day. Machine hours per day was calculated by dividing the total number of hours logged on all the machines in a week by the number of days in the week, and then dividing the result by the number of CMC machines (8) in the Card Punch Section (CPS).

In June 1976, 6 months before PCRS implementation, machine usage during an average 24-hour work day (three shifts) was approximately 8 hours per machine. Over the remaining 6 months of the year, a few simple procedural changes and work improvements increased machine hours per day to 11 hours in September and to 13 hours in December 1976.

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[1]A seventh criterion variable, job turnover, is to be studied in a long-term follow-up study. The ability of the work motivation and performance model to predict productivity and related criterion variables is discussed in Nebeker, Dockstader, and Shumate (1978).

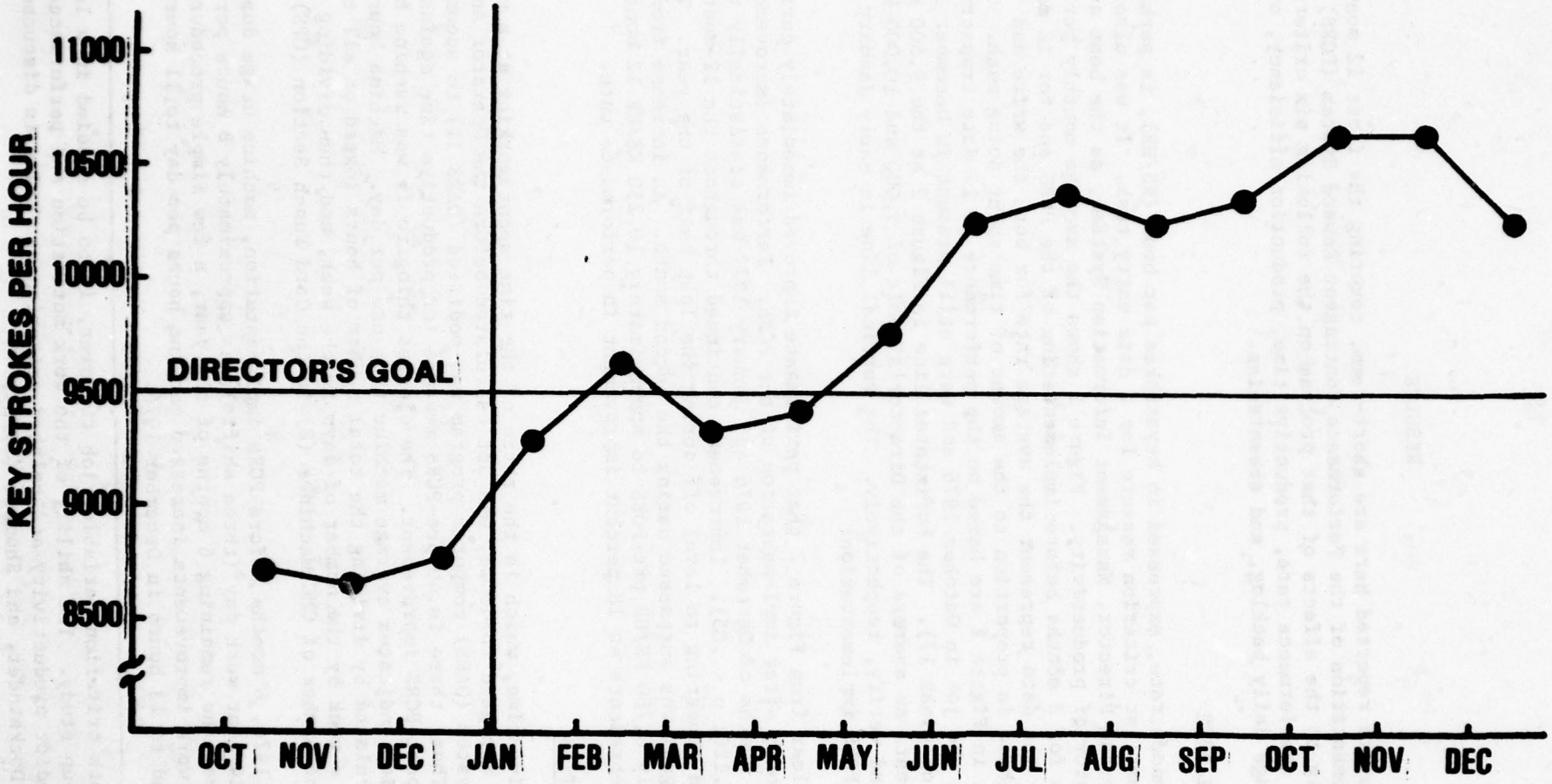

Figure 2. Average monthly performance rates (KS/HR) under pre- and post-Performance Contingent Reward System implementation conditions.

The PCRS was implemented in January 1977, and machine hours remained at 13 hours until mid-March. Then, the measure dropped to 12 hours in April and to 11 hours in May. LBNS's explanation for the downward trend was that the CPS was running out of work. The situation was not a result of an overall decrease in workload; rather, it appeared to be a direct result of the program's effect on productivity.

Thus, while machine hours per day provided a fairly good measure of productivity, it was dependent upon work availability. Productive time was a better measure of individual work management because it was tied directly to individual effort and was independent of workload. It would have been preferable to provide a pre- and post-PCRS comparison of productive time but, again, pre-PCRS productive time data were not available.

A communications problem, however, did provide some data to serve as a rough estimate of pre-PCRS productive time: The data transcribers did not know that the PCRS was in effect until the end of the second week in January. The first 2 weeks were therefore functionally pre-PCRS. Two weeks of data do not provide an adequate base line for comparing pre- and post-PCRS performance, but they at least allow an empirical estimate of pre-PCRS productive time. The average productive time for the first 2 weeks in January was 98 percent for the 17 transcribers whose data are presented in Figures 3, 4, and 5. The total shop average, including the 17, was much lower at 79 percent.

Figure 3 shows that there was little improvement in productive time for the first 4 months of the program, followed by a significant improvement in May and June with gradual improvement thereafter. Possible explanations for the data include the following:

1. In April, machine hours per day began to decrease. Discussions with the data transcribers indicated that some of them did not fully understand the importance of working longer as well as faster.

2. The first bonus checks were awarded in April, effectively dispelling any doubts about actually receiving monetary rewards for high performance.

3. Hearing that high performance would earn bonuses may have had less motivational force than actually receiving them or seeing co-workers receive them.

Production Efficiency

Overall production was the product of performance efficiency and productive time. (Performance efficiency, as described earlier, was simply the ratio of an individual's actual speed and the established standard speed for the procedure under consideration.)

Figure 4 shows a rather unsystematic trend for production efficiency (similar to that for productive time) during the first 4 months of the program. From May to December, however, production efficiency increased substantially, reflecting improvements in both performance rate and productive time.

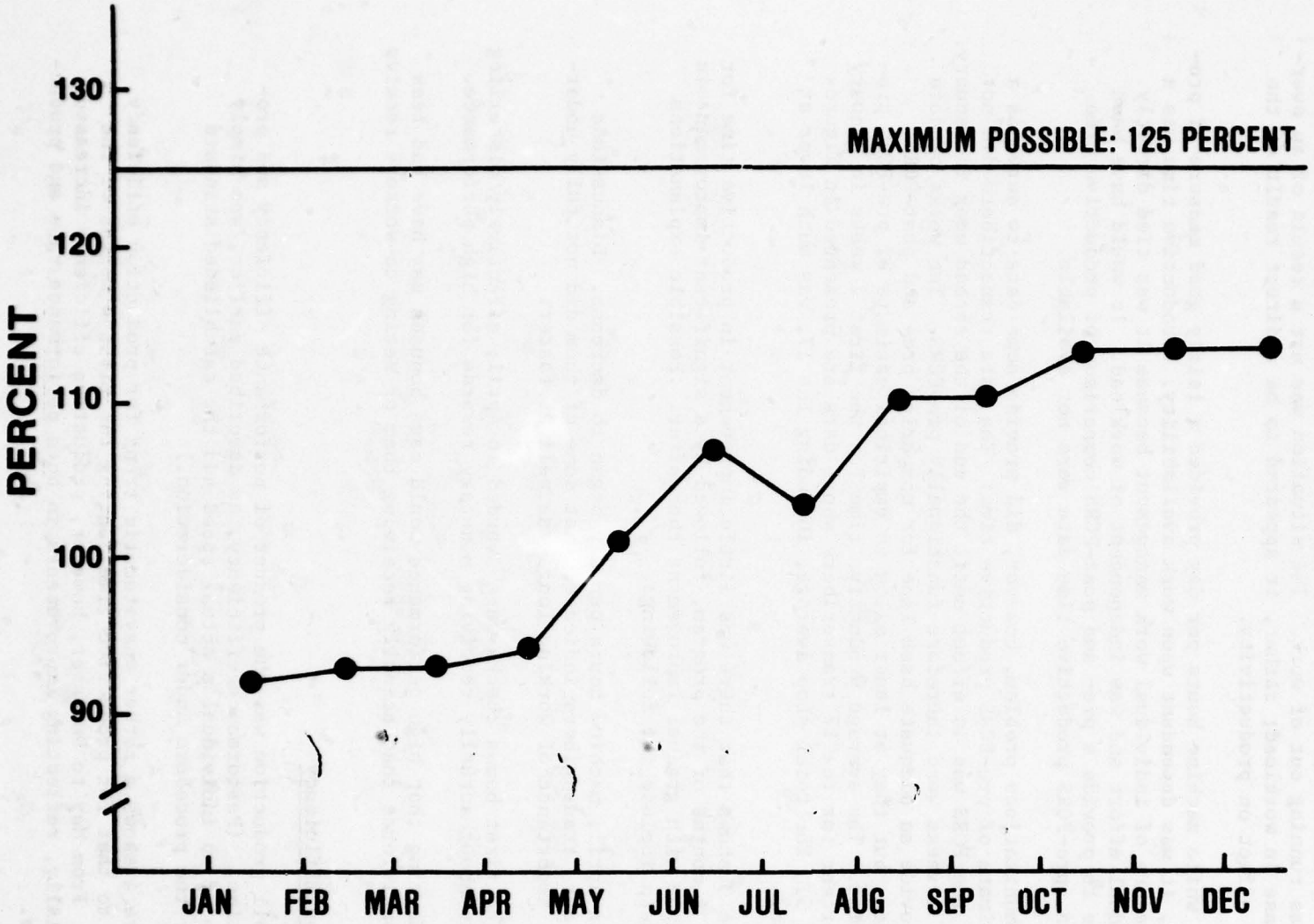

Figure 3. Average monthly productive time over 12-month Performance Contingent Reward System trial period.

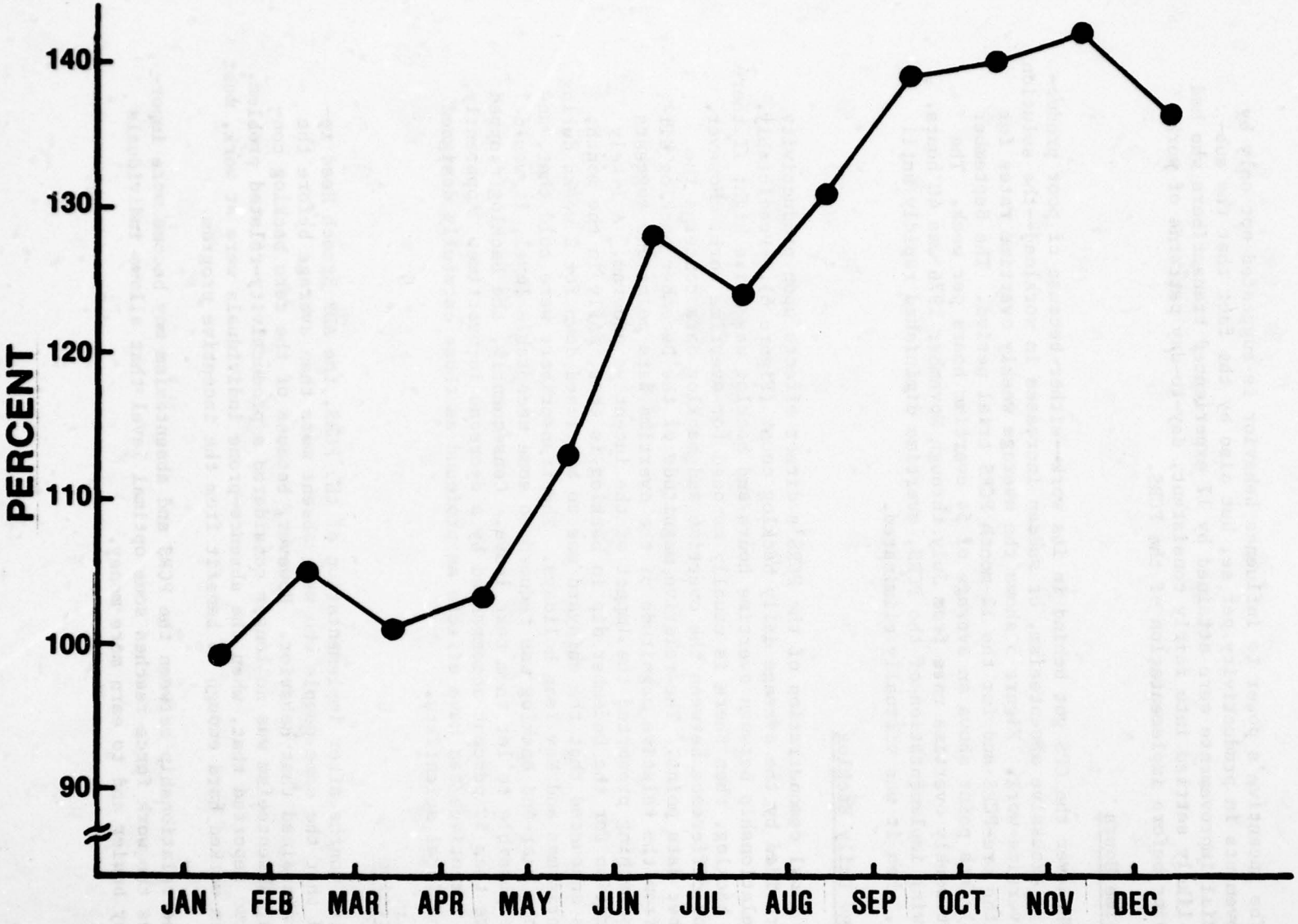

Figure 4. Average monthly production efficiency over 12-month Performance Contingent Reward System trial period.

The incentive's power to influence behavior is suggested not only by improvements in productivity per se, but also by the fact that the substantial improvements were attained by 17 experienced transcribers who had very likely settled into fairly consistent, day-to-day patterns of work behavior before implementation of the PCRS.

Overtime Hours

Whenever the CPS got behind in its work--either because of poor productivity, excessive absenteeism, or sudden increases in workload--the solution was overtime work. Figure 5 shows the average weekly overtime rates for 4 months pre-PCRS and for the 12-month PCRS trial period. The September (1976) data point shows an average of 54 overtime hours per week. The lowest weekly overtime rate from July through November 1976 was 40 hours. Following implementation of the PCRS, overtime diminished rapidly until April, when it was virtually eliminated.

Average Daily Backlog

A final demonstration of the PCRS's direct effects upon productivity was provided by the average daily backlog count (Figure 6). Predictably, the relationship between overtime hours and backlog was quite high; if there is no backlog, then there is usually no need for overtime work. However, a major difference between the overtime and backlog data concerns the December data point. The relative magnitude of the December backlog differs from the relative magnitude of the overtime data point and suggests that something preempted the impact of the incentive program. A likely explanation for the December dip in backlog is that, early in the month, it was announced that the shipyard was to be closed down for 2 weeks during the Christmas and New Year holidays. The transcribers were told that, unless the year-end backlog was reduced to some acceptable level, it would not be possible to let them take leave. Consequently, the backlog dropped by more than 50 percent accompanied by a decrease in overtime. Apparently, other incentives can have effects as profound as those carefully designed by behavioral scientists.

Absenteeism

Five months after implementation of the PCRS, the ADP Branch Head reported that the same people who were absent more than average before the PCRS maintained that behavior. However, because of the zero backlog condition, absenteeism was no longer considered a productivity-related problem. She also reported that, when the absence-prone individuals were at work, most of them worked hard enough to benefit from the incentive program.

The relationship between the PCRS and absenteeism may become more important as the work force reaches some optimal level that allows individuals to stay busier and to earn more money.

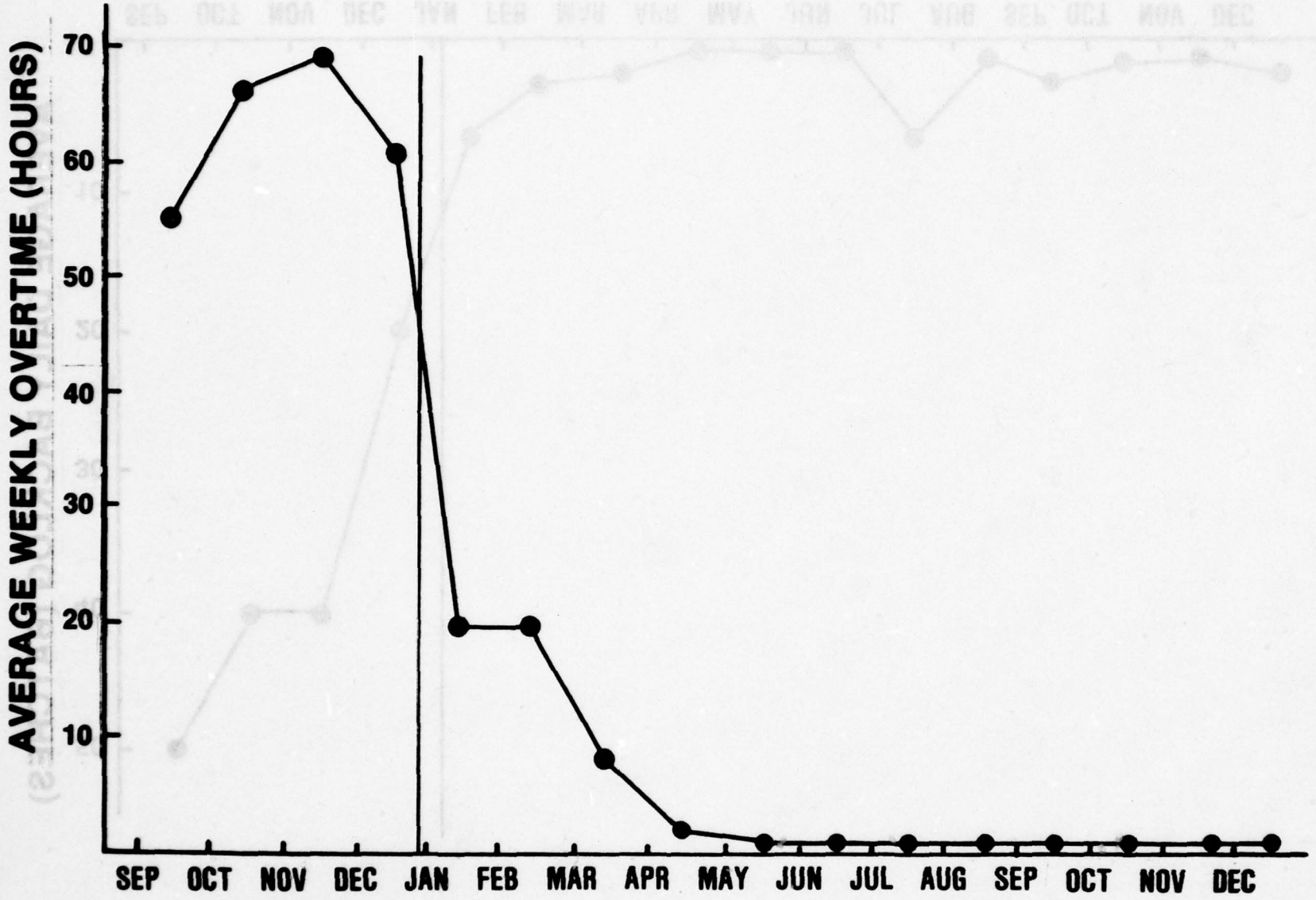

Figure 5. Average weekly overtime hours worked before and after implementation of the Performance Contingent Reward System.

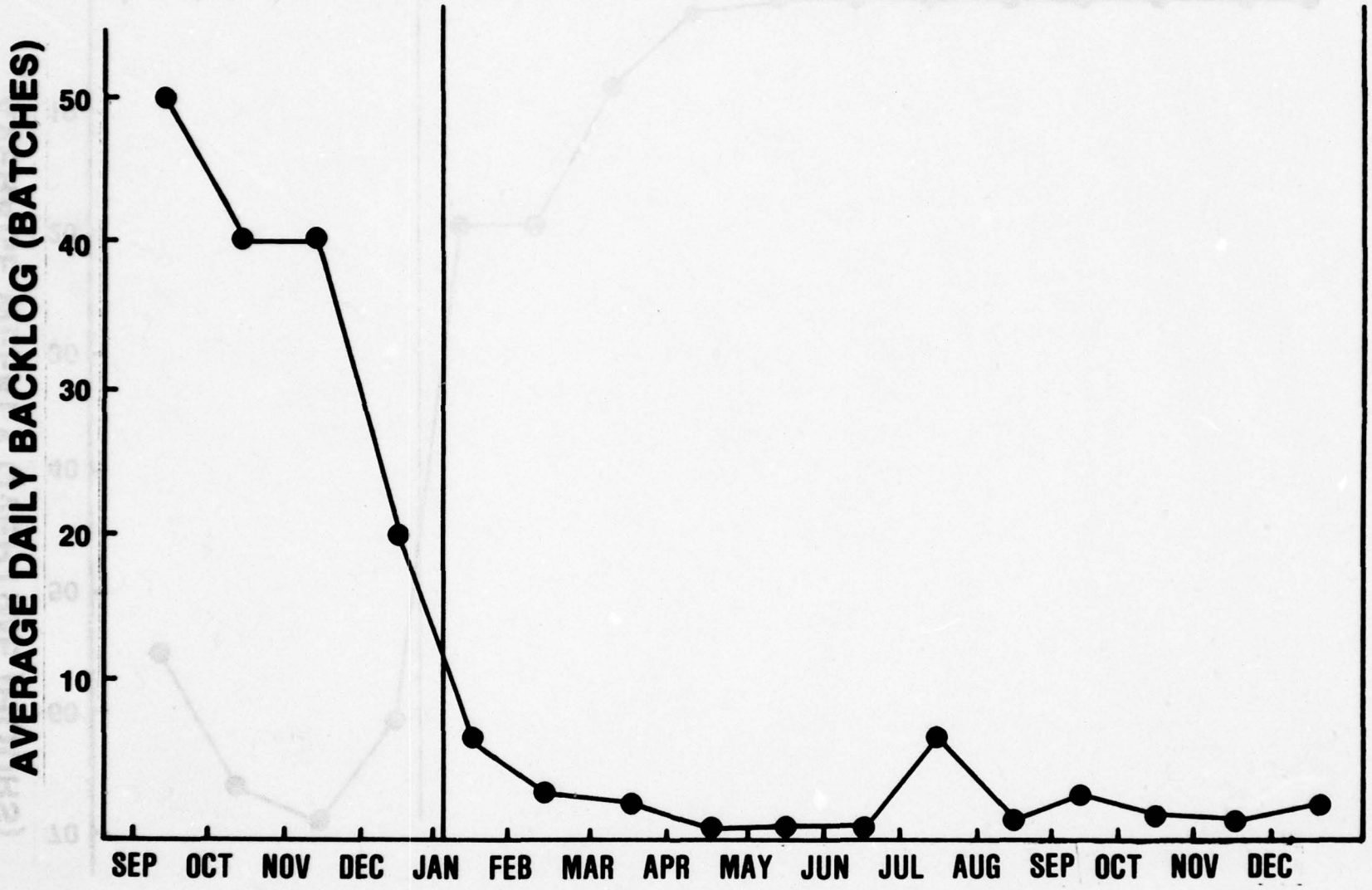

Figure 6. Average daily backlog before and after implementation of the Performance Contingent Reward System.

Financial Analysis

The impact of the PCRS upon productivity during the 12-month trial period was substantial, as reflected by any of the productivity measures employed. From a managerial perspective, however, there is another important consideration regarding incentive programs: net economic value. The question is whether the improvement was worth the time and resources expended. Nearly any human endeavor can effect improvement in productivity if sufficient resources (e.g., money, man-hours, material) are committed. However, to an organization, the goal is to obtain savings that exceed costs. Unfortunately, too many management intervention attempts receive little or no evaluation in terms of productivity, let alone cost. This is particularly characteristic of government operations where there are no profit incentives. The LBNS project, however, was subjected to a rigorous financial analysis (see Bretton, Dockstader, Nebeker, & Shumate, 1978). A brief summary is presented here.

The financial evaluation was conducted using a fixed-effectiveness model of cost-effectiveness analysis. The model's basic premise is that, when one is provided with a set of alternatives to solve a problem and all solutions are essentially equivalent in effectiveness (i.e., getting the work done), the preferred alternative is selected on the basis of cost. The alternatives in this case were to use or not to use the PCRS to improve CPS productivity.

To estimate the cost effectiveness of the PCRS, the productivity of the 17 data transcribers was monitored during the 13-week base period (5 July to 2 October 1977) before implementation of the PCRS and during the 13-week PCRS trial period (17 January to 16 April 1977). Trial-period production-cost savings were derived from a comparison of the production costs and outputs of the base and trial periods. Briefly, the costs incurred by the PCRS for the trial period were determined and separated into nonrecurring costs associated with implementation of the program and recurring costs associated with actual production and system maintenance. Nonrecurring or setup costs included equipment purchases, software development, personnel training, and unrecorded miscellaneous expenses (estimated at 10 percent of other nonrecurring costs). Recurring costs associated with production were, for the most part, determined by the Recharge Rate, which represented the organization's overall hourly cost for a data transcriber.

The following results provide a better perspective of the economic value of the PCRS as it was implemented at LBNS:

1. The total setup cost was recovered in less than 13 weeks; savings accruing thereafter were realized by the government.

2. When the number of CPS data transcribers is changed from 17 to 26 (the total number in the section) and the cost savings are projected to 1, 3, and 5 years, the savings amount to $66,000, $221,000, and $412,000, respectively.

3. If the results of the study can be generalized to similar key-entry work centers in the remaining seven shipyards and the rest of the Navy Material Command, then the savings projections reach $17.2 million in 5 years. This

projection is based, in part, on NAVMAT's estimate of 725 people performing key-entry work. As for the validity of generalizing the LBNS results to other work sites, corroborating data have been collected in a similar study at Mare Island Naval Shipyard.

4. The method and figures used to calculate "savings" for the LBNS project were extremely conservative. First, production efficiency (Figure 5) during the trial period accelerated over time, with marked improvements in May and June. Consequently, the post-PCRS measures, which were taken before May, would be conservative compared to measures taken during periods of substantially increased performance. Second, work force variables (e.g., personnel replacement costs) were not included in the present study, although they should be included in financial analyses for subsequent implementations.

In short, the PCRS established at LBNS not only increased production efficiency substantially but also recouped its own nonrecurring costs in less than 3 months.

DISCUSSION AND CONCLUSIONS

Although caution must be exercised in drawing conclusions or in making generalizations regarding the long-term effects of the Performance Contingent Reward System (PCRS), the findings of this study indicate that an effective work incentive program can be established under current federal and Navy guidelines. At the Long Beach Naval Shipyard (LBNS), managers and transcribers alike have commented favorably on the program, and the shipyard's Commanding Officer asked to have similar efforts begun in other areas of the organization.

Productivity

A manager's main interest in the PCRS that was implemented at LBNS would probably be its effect on productivity. In the present study, productivity improved considerably, as reflected in (1) an increase in production efficiency, in terms of both performance rate and productive time, and (2) the virtual elimination of backlog and overtime.

The overall improvement in productivity was reflected in other less obvious but significant ways. For example, six transcribers who were on board when the PCRS was implemented left the Card Punch Section (CPS). After 12 months, the six had not been replaced, but the CPS had experienced no negative effect on productivity and thus saved the cost of hiring, training, and paying six people.

Another significant indicator of increased productivity was suggested by the possibility of changing the CPS from a three- to a two-shift operation. Management had considered such a change but had not attempted it, partly because of the section's excessive workload. With the increase in productivity and the reduction of backlog and overtime, a two-shift operation appears feasible.

Program Administration

An important characteristic of any personnel management program is its administrative cost in terms of time, material, and human resources. The Long Beach PCRS required little administration time once it was installed because most of the work was accomplished by computer. Criterion variables were monitored closely to detect changes requiring program adjustment, but the computer collected and stored most of the required information, calculated all of the values associated with the program, and presented all of the relevant information required to monitor the program on a weekly basis.

Organizational Role

An incentive program designed specifically to increase productivity should not preempt other kinds of incentive activities. Productivity is only one job behavior; the organization must decide what other behaviors need attention and where other incentive programs might prove beneficial. The PCRS frees the supervisor to concentrate on other supervisory activities, including the management of incentives directed toward other work behaviors.

One advantage of a PCRS is that, where a supervisor lacks the skills needed to administer an effective incentive program, there is enough structure in the system to increase the likelihood that at least one aspect of work behavior is rewarded--in the present case, productivity.

Successful interaction between the supervisor and a computer-administered PCRS is highly dependent upon the supervisor's initiative and creativity. He can view the PCRS's mechanization either as bypassing him and thus attenuating his power or as a valuable tool that provides the kind of job performance information needed for effective work management.

By-products

Disregarding the incentive aspects of the program, the by-products of organizational preparation for a PCRS (e.g., the development of hard production measures, an automated production monitoring system, and work standards) are valuable managerial tools themselves. Moreover, the incentive program clearly identifies for operators what behaviors are important to the organization. Such specification allowed the transcribers to set goals and, with the feedback provided, compare their performance with that of their work group. Therefore, in addition to benefitting from the motivating properties of the reward alone, management also reaped the benefits of goal setting and feedback, both of which have been shown to have positive effects upon performance (Dockstader, Nebeker, & Shumate, 1977).

Permanence

The PCRS described in the present report may be seen as a technology, or the product of technology, put to use by behavioral engineers much as a new hardware system is applied by electronics engineers. However, a major difference in working with human resources is the need to proceed in a manner that is acceptable to both the organization and its people.

One chief advantage of a product of technology is its relative permanence. For example, when the Navy orders a new shipboard weapon system, the new system becomes an integral part of the ship regardless of the inclinations of the Commanding Officer or his staff. Management programs do not usually enjoy such permanence; rather, they can be either used or disregarded. Incentive systems, which are a subset of management systems, may be especially vulnerable to rejection following organizational change--particularly change in leadership. Some managers simply don't believe in incentive systems, while others lack the knowledge required to design and implement such programs effectively. Many programs have failed because their designers lacked knowledge of basic behavioral principles. Finally, in some of those rare instances where individuals have had both inclination and skill, the success and continuity of the programs depended upon the efforts of those individuals: when they left, the programs ended. Not so with the present PCRS: 2 months after the system was implemented at LBNS, the Director who had been instrumental in its initiation there resigned, but his departure had no perceptible impact on the program. It would thus seem that the PCRS, being a product of technology rather than just another management program, has gained a degree of permanence at LBNS that is analogous to that of a new shipboard weapon system.

RECOMMENDATIONS

1. Performance Contingent Reward Systems should be developed, implemented, and evaluated in other work centers where the work performed is similar to that described in the present report.

2. Currently, the major emphasis of federal and Navy incentive awards programs is on "suggestion systems." Pertinent regulations should be revised to encourage managers to develop effective performance-improvement programs.

3. Potential awards that are not available under existing federal regulations should be investigated. For example, time off is not available as a work incentive for civil service employees, but it may have powerful incentive characteristics. Time off could be studied using a military population where such an award is possible.

4. Research and development should be directed toward (a) identifying and testing the effects of other monetary and nonmonetary rewards upon productivity, (b) designing work incentive systems for different and more complex jobs, (c) testing the effects of different performance-reward contingencies upon productivity, including the manipulation of temporal and magnitude of reward variables, and (d) determining more precisely the impact of incentives upon performance when the effects of such items as improved systems design, performance feedback, and goal setting have been taken into account.

REFERENCES

Belcher, D. W. Compensation administration. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1974.

Bretton, G. E., Dockstader, S. L., Nebeker, D. M., & Shumate, E. C. A performance contingent reward system that uses economic incentives: Preliminary cost-effectiveness analysis (NPRDC Tech. Rep. 78-13). San Diego: Navy Personnel Research and Development Center, February 1978. (AD-A050 830)

Campbell, D. T., & Stanley, J. C. Experimental and quasi-experimental designs for research. Chicago: Rand McNally, 1963.

Campbell, J. P., Dunnette, M. S., Lawler, E. E., III, & Weich, K. E., Jr. Managerial behavior, performance, and effectiveness. New York: McGraw-Hill, 1970.

Dockstader, S. L., Nebeker, D. M., & Shumate, E. C. The effects of feedback and an implied standard on work performance (NPRDC Tech. Rep. 77-45). San Diego: Navy Personnel Research and Development Center, September 1977. (AD-A045 430)

Federal Personnel Manual, Chapter 451, Incentive Awards, 1976.

Fein, M. Wage incentive plans. In H. B. Maynard (Ed.), Industrial engineering handbook (3rd ed.). New York: McGraw-Hill, 1971.

Grillo, E. V., & Berg, C. J. Work measurement in the office: A guide to office cost control. New York: McGraw-Hill, 1959.

Locke, E. A. Toward a theory of task motivation and incentives. Organizational Behavior and Human Performance, 1968, 3, 157-189.

Locke, E. A., Cartledge, N., & Knerr, C. Studies of the relationship between satisfaction, goal setting, and performance. Organizational Behavior and Human Performance, 1970, 5, 135-138.

Nebeker, D. M., Dockstader, S. D., & Shumate, E. C. Predictions of key entry performance using the reconceptualized expectancy model (NPRDC Tech. Rep. 78-11). San Diego: Navy Personnel Research and Development Center, January 1978. (AD-A050 583)

Nebeker, D. M., & Moy, M. C. Work performance: A new approach to expectancy theory prediction (NPRDC Tech. Rep. 76TQ-47). San Diego: Navy Personnel Research and Development Center, September 1976. (AD-A030 451)

Patten, T. H., Jr. Relating learning theory to behavior change in organizations. Human Resource Management, 1974, 13, 27-36.

Ward, J. H., Jr., & Jennings, E. Introduction to linear models. New Jersey: Prentice-Hall, 1973.

APPENDIX A

RELEVANT THEORIES

RELEVANT THEORIES

Expectancy Theory

Expectancy theory is currently the most widely researched theoretical model for studying work motivation and productivity. It belongs to an emerging class of motivation theories referred to by some investigators (Lawler, 1973; Adams, 1963; Vroom, 1964) as "process" theories in contrast to "content" theories (Maslow, 1943). Whereas content theories describe the needs, motives, and goals of the individual, process theories focus on how or why individuals direct their activities and behaviors toward the attainment of those needs. Expectancy theory postulates that the strength of the motivation toward an act or behavior is dependent upon the joint function (combination) of (1) an individual's perceived expectation that an act or behavior will lead to specific outcomes, and (2) the values of those outcomes to the individual (see Vroom, 1964; Porter & Lawler, 1968, for applications of expectancy theory in organizational settings).

In symbolic notation, the general expectancy model (see Vroom, 1964) may be represented by the equation:

$$F = E \times V,$$

where F = the force to engage in a particular behavior,

E = the expectation that a given behavior or level of behavior will lead to a specific outcome, and

V = the valence (value) of the outcome.

For example, if the behavior of interest is productivity, then the level of productivity may be perceived as performing a job at different work rates. There are likely to be a number of different outcomes associated with working at these different rates; namely, less time to socialize with co-workers, feelings of accomplishment, fatigue, recognition by the supervisor, disapproval by peers, and promotion. Most outcomes have either a positive or negative valence in varying degrees for a given individual. Since there are usually more than one possible outcome expected for a given rate of work, the expectancy and valence associated with each outcome are combined to determine a single value that indicates the degree of attractiveness of the behavior of interest.

The key factor is the individual's expectation that working at different rates will, in fact, lead to the desired outcomes. According to this theory, a person's behavior will not necessarily be determined by the outcome wanted most unless there is also a high enough expectation that the required behavior will lead to that outcome. (See Nebeker, Dockstader, & Shumate, 1978 for a detailed application of expectancy theory to the project described in this report.)

Goal Theory

Locke's (1968) theory of goal setting, or goal theory, states that an individual's conscious intentions or goals determine behavior. The theory's

motivational aspects are specified in a set of propositions, including the following: (1) specific goals increase performance more than generalized goals, and (2) difficult (but attainable) goals result in higher performance than easy goals. According to proposition (1), and in the context of the study, setting a performance goal of 9,000 keystrokes per hour (KS/HR) would increase performance more than simply asking operators to "do their best." In accordance with proposition (2), setting a goal of 10,000 KS/HR would produce higher performance than setting a goal of 9,000 KS/HR. Propositions (1) and (2) have received strong support (see Latham & Yukl, 1975 for a review of research on the application of goal setting in organizations).

Pritchard and Curts (1973) state that incentives will not improve performance beyond individually determined goals, but their proposition lacks unequivocal empirical support.

Finally, a proposition tested in LBNS's Card Punch Section states that individuals will set goals spontaneously if they receive feedback about their performance relative to a performance standard. The results of this part of the study are reported briefly in this report and in greater detail in Dockstader, Nebeker, and Shumate (1977).

Incentive Theory

Logan (1971) said that incentive "is typically the most critical determinant of choice" and provides "the greatest selective control over behavior" (p. 47), thus agreeing with a central assumption of both expectancy theory and goal theory: that individuals can make conscious choices regarding their behavior (e.g., level of effort).

However, incentive theory offers a somewhat different approach to the study of motivation than expectancy and goal theory. A principal area of research is the study of the conditions of reward. One such condition is delay of reinforcement, which stresses the importance of the most recent reward versus prior rewards in determining behavioral choices. There are some interesting ramifications of this idea with respect to the timing of rewards in a work environment.

When the term "incentive" is used in the context of motivation in organizations, its referent is usually some tangible, external reward such as a bonus or a promotion. In the context of an incentive theory of behavior, however, the term "incentive" has an entirely different meaning, being a hypothetical construct referring to an individual's expectation of reward. To paraphrase Logan (1960), if an individual's level of performance is increased or decreased by a reward previously received for that level of performance, then some internal consequent of the reward must be present while he is engaged in that job performance. "Incentive" is the word for "the internal consequent."

Conditions of reward that have received considerable attention in the experimental investigation of incentive as a theoretical construct and that would appear to be of interest in the administration of incentive awards in organizations include the size of the reward, the nature of the contingency

between performance and reward, and the modification of rewards to maintain an optimal effect as behavior changes across time.

REFERENCES

Adams, J. S. Toward an understanding of inequity. Journal of Abnormal and Social Psychology, 1963, 67, 422-436.

Dockstader, S. L., Nebeker, D. M., & Shumate, E. C. The effects of feedback and an implied standard on work performance (NPRDC Tech. Rep. 77-45). San Diego: Navy Personnel Research and Development Center, September 1977.

Lawler, E. E., III. Motivation in work organizations. Monterey, CA: Brooks-Coles, 1973.

Locke, E. A. Toward a theory of task motivation and incentives. Organizational Behavior and Human Performance, 1968, 3, 157-189.

Logan, F. A. Incentive. New Haven: Yale University Press, 1960.

Logan, F. A. Incentive theory, reinforcement, and education. In R. Glaser (Ed.), The nature of reinforcement. New York: Academic Press, 1971.

Latham, G. P., & Yukl, G. A. A review of research on the application of goal setting in organizations. Academy of Management Journal, 1975, 18, 824-845.

Maslow, A. H. A theory of human motivation. Psychological Review, 1943, 50, 370-376.

Nebeker, D. M., Dockstader, S. D., & Shumate E. C. Predictions of key entry performance using the reconceptualized expectancy model (NPRDC Tech. Rep. 78-11. San Diego: Navy Personnel Research and Development Center, January 1978. (AD-A050 583)

Porter, L. W., & Lawler, E. E., III. Managerial attitudes and performance. Homewood, IL: Irwin, 1968.

Pritchard, R. D., & Curts, M. I. The influence of goal setting and financial incentives on task performance. Organizational Behavior and Human Performance, 1973, 10, 175-183.

Vroom, V. H. Work and motivation. New York: Wiley, 1964.

APPENDIX B

SHIFT ACTIVITY REPORT

SHIFT ACTIVITY REPORT

16:13 05/10/76-1

SYSTEM STOPPED

SELECT: 19.

SHIFT ACTIVITY

PRINT STATISTICS

OPR	WMIN	WKSTRK	WREC	KS/HR		VMIN	VKSTRK	VREC	KS/HR		CORR
C 30					:	75	10199	242	6159		
C 36	117	1421	45	728	:	44	5176	210	7058	:	4
C 38	65	8979	221	8288	:	226	33246	888	8826	:	3
C 52	204	26464	363	7783	:					:	45
C 53	147	15944	323	6507	:	123	15250	437	7439	:	35
C 62	297	10698	173	2161	:					:	85
C 63	182	22588	416	7446	:	107	17112	491	9595	:	12
C 90					:	69	12249	127	10651		
C 91	67	11161	127	9994	:	41	7825	96	11451	:	8
C 93	139	12395	128	5350	:					:	3

Explanation of Abbreviations:

OPR = Operator number.

WMIN = Machine use (in minutes) in the "write" mode.

WKSTRK = Total keystrokes in specified interval in the "write" mode.

KS/HR = Rate of performance in keystrokes per hour.

WREC = Total records produced in specified interval in the "write" mode.

VMIN = Machine use (in minutes) in the "verify" mode.

VKSTRK = Total keystrokes in specific interval in the "verify" mode.

VREC = Total records produced in specified interval in the "verify" mode.

CORR = Errors corrected during verification.

APPENDIX C

INTERVIEW QUESTIONS

INTERVIEW QUESTIONS

1. What kinds of problems are there that prevent you from performing at your best in this department?

2. What particular kinds of things do you like about your job; that is, why do you choose to work here rather than other places?

3. What particular things do you dislike about this job?

4. What kinds of things do you look for in a job? (Jobs in general)

5. What kinds of things do you look out for in a job? (Jobs in general)

6. What kinds of alternative jobs are there available to you?

7. What do you think is a reasonable rate of work for the new CMC machines?

   a. Do you know your average KS/HR?

   b. Estimate what that rate is.

   c. What would you consider optimal in terms of KS/HR?

   d. What would you consider as minimal KS/HR?

APPENDIX D

RESPONSIBILITIES OF THE INCENTIVE MANAGEMENT COORDINATOR

RESPONSIBILITIES OF THE INCENTIVE MANAGEMENT COORDINATOR

1. Responsibilities toward performance capabilities:

    a. Ensure efficient equipment usage.
    b. Maintain an efficient work flow.
    c. Develop efficient CMC procedures.
    d. Ensure that physical surroundings are laid out well:

        (1) Work patterns are convenient.
        (2) Work area is neat and clean.

    e. Ensure that shift supervisors understand and accept Incentive Management System.
    f. Ensure that source documents are well designed and carefully prepared.
    g. Determine training needs.
    h. Develop standards for operator selection.

2. Responsibilities toward performance motivation:

    a. Know and understand the incentive program and be able to train the supervisors and operators in its use.
    b. Develop ways to offer other types of incentives (e.g., shift incentives, nonmonetary rewards, etc.).
    c. Provide for awards to be given to those who contribute to keypunch in ways not covered by the incentive plan.
    d. Ensure that incentive awards are presented in a timely manner.
    e. Provide a means to reward shift supervisors for their contributions to the performance of their subordinates.
    f. Answer questions about the incentive management program.

3. Responsibilities toward performance measurement and reporting:

    a. Ensure that the OARS report is produced on schedule and is functioning properly.
    b. Monitor the accuracy of standards, and develop standards for new CMC procedures.
    c. Collect and monitor management information that will help evaluate the program, including the following:

        (1) Shift and shop production.
        (2) Labor costs.
        (3) Leave rates (annual, sick, and LWOP).

4. Miscellaneous responsibilities:

    a. Inform upper management of the program's progress.
    b. Inform the union of actions taken that concern its members.
    c. Monitor the incentive program's effectiveness and identify problem areas needing attention.

APPENDIX E

OPERATOR ANALYSIS REPORTING SYSTEM II

DPD KEYPUNCH SECTION
CMC KEYPROCESSING SYSTEM
ANALYSIS BY OPERATOR

17 JUN 1977

S	OPR	DATE	ACCT CD	EFF	KS/HR A	KS/HR V	STD/HR W	STD/HR V	% EFF W	% EFF V	% EFF A	CORR	PERCENT TIME W	PERCENT TIME V	PERCENT TIME IBM	PERCENT TIME OTH	PRO TIM	PROD EFF	TOTAL STD HRS	EXPECTED HRS	BONUS
*1	052		5080004	0127	9025	9786	7500	9000	120	109		10							160.03		
*1	052		5080005	0126	4649	9773	4000	6000	116	163									38.25		
*1	052		5080006	**0021	1383		5500	7000	25										38.63		
*1	052		6055004	*0007	4977				100										3,94		
*1	052		6055017	0515	2175		5500	7000	40										16.07		
*1	052		6055040	0194	5263		5500	7000	96										21.22		
*1	052		6055043	0535	4789		5500	7000	87										3,97		
*1	052		6055046	0540	4508	6256	4000	6000	113	104		9							48.98		
1	052		9052501	0640	7379		5500	7000	134										12.09		
*1	052		9052501	0640	6121	8691	5500	7000	111	124		6							166.25		
*1	052		905461A	0630	6142	10098	5500	7000	148	144		34							115.19		
*1	052		905461B	0645	6647	7793	5500	7000	121	111		18							38.50		
*1	052		905461C	0001	6200		5500	7000	113										48.98		
*1	052		905461E	*0057	6697				100										17.6		
*1	052		9055001	*0775		1560				100									11.9		
*1	052		9055002	*0785	1560				100										11,97		
1	052		**********	****	9666	11276			123	115	120	126	27	15	30	27	125	150	54.59	40:00	17.51
*1	052		**********	****	8383	10294			116	113	115	2111	53	18	10	19	105	121	961.51	823.00	48.11

BONUS PAID TOTAL BONUS PAID 134,43

E-1

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